

DUAL ELECTRODE WITH THREE STUDS FOR IMPEDANCE  
CARDIOGRAPHY

BACKGROUND OF THE INVENTION

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1. Field of Invention

The present invention relates to medical electrodes.  
More particularly, the present invention relates to  
medical electrodes that can be used in impedance  
10 cardiography.

2. Description of the Related Art

Impedance cardiography (ICG) is a medical test to  
determine the pumping capacity of the heart. ICG is a  
15 non-invasive and cost-efficient technique for  
determining stroke volume (SV), cardiac output (CO),  
and thoracic fluid volume (TFC, or ZO). Impedance  
cardiography is also referred to as "Non-Invasive  
Continuous Cardiac Output" (NiCCO). Impedance  
20 cardiography also provides the physician with a  
measurement of cardiac output without the need for  
catheterization, an invasive procedure that is  
expensive and poses some risk to the patient.

ICG normally requires four pairs of electrodes,  
25 each pair spaced approximately 50 mm apart. Existing  
products in the prior art require separate cable  
connections for each of the electrodes.

To date, there is one double electrode being used 5 for impedance cardiography by CardioDynamics of San Diego, California. This product has two sensing elements, separated by 50 mm, each electrode  
5 connected directly to the same size snap stud. The prior art also includes single-electrode sensors which have offset studs. In some cases, the offset was done to minimize migration of corrosive coupling agents. In other cases, a single electrode was  
10 provided to make two connection points.

However, there is a need in the art for an electrode structure that permits electrodes to be connected quickly without separate cables.

#### 15 SUMMARY OF THE INVENTION

The present invention provides a disposable medical electrode pair with an additional stud that is mounted near one stud but is electrically connected to the other, thus bringing the two  
20 connection points close together and allowing the pair of electrodes to be connected simultaneously with a two-conductor connector. In other words, instead of requiring a dual connector to be larger than the (50 mm) distance between the two electrodes,  
25 the current dual electrode assembly permits use of a much smaller connector that is only slightly larger than the distance between the proximal stud and the

additional stud, yet keeps the electrodes on the patient side spaced at the optimal distance.

According to an aspect of the invention, the arrangement of the two connections close together  
5 advantageously allows the simultaneous connection of both, which permits increased speed of installation and convenience to the practitioner. Such increased speed and convenience can be critical, especially since this invention could be used on patients  
10 requiring emergency life-saving care. Accordingly, the increased speed and convenience is extremely desirable.

In addition, the arrangement of the two connections close together allows securing the two  
15 wires to each other, reducing the tendency of the capacitance between the wires to change and create electrical noise.

Moreover, the arrangement of the two connections together makes the system less intrusive for the  
20 patient, so it appears to the patient that four connections are being made instead of eight.

According to an aspect of the invention, the medical electrode or sensor preferably would be disposable. Making the double electrode more  
25 convenient to use also discourages users from substituting individual standard ECG electrodes, a

practice that would introduce variability into the test results.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5           Fig. 1a illustrates a patient-side perspective of an aspect of the electrode apparatus according to the present invention.

          Fig. 1b illustrates a cross-section view of the electrode apparatus shown in Fig. 1a.

10           Fig. 1c illustrates a cable-side perspective of an aspect of the electrode apparatus according to the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

15           It is understood by persons of ordinary skill in the art that the illustrations and description herein are provided for purposes of explanation, and the claimed invention is not limited to the embodiments shown and described, as an artisan can make  
20           variations in the design that lie within the spirit of the invention and the scope of the appended claims.

          Fig. 1a shows the patient side of an electrode apparatus according to the present invention. The  
25           body of electrode 100, in a best mode, would comprise a pressure sensitive adhesive-coated foam similar to that used in other electrodes. However, a solid gel

101, 102 (shown in Fig. 1a) is preferred over a liquid gel. A liquid gel would be poured into the cavities in the assembly after the studs, label, etc. are assembled to the foam. The gel sections 101, 102, each of which may be a differing size and shape, adhere to the eyelets (base) 101a, 102a, each part of a snap assembly, which are secured to the foam base when the stud parts 106, 108 of the assembly are pressed on.

10           Adhesive on the label 103 secures it to the foam 100, as holes in the foam form wells for the gels. The distal snap assembly 101a, 108 includes an eyelet 101a and a distal stud 108, and the distal snap assembly also secures one end of an electrically-  
15           conductive jumper 104 and may be covered by an electrically insulating cap 107 of various designs. The electrically-conductive jumper may be made from foil, plated plastic, or other material or even printed on the label, and may include an insulating  
20           layer if required.

          The additional snap assembly 105a, 105 includes eyelet 105a and additional stud 105, and this assembly secures the proximal end of the jumper, but it is electrically isolated from the patient. This is  
25           achieved by securing it to the label, without penetrating the foam, or by using a non-conductive eyelet 105a (Fig. 1a) or by other means. The final

result is two solid gel sections 101, 102 on the patient side (shown in Fig. 1a) arranged substantially 50 mm apart, and an additional stud 105 located substantially 15 mm from proximal stud 106 and 35 mm from distal stud 108 (Fig. 1c).

The connections are preferably made to the additional stud 105 and to the proximal stud 106, approximately 15 mm from it. Ideally, the additional stud 105 can be a different size than the proximal and distal studs 106, 108 that hold the electrode gels, thus precluding inadvertent exchange of the two connections. Ideally, the connector on the cable side can conveniently make both connections simultaneously.

Some of the many aspects of the instant invention, in addition to those previously mentioned in the summary of the invention, include that the electrode is compatible with a very inexpensive cable if it is necessary to forego a double connector type cable for a lower-cost cable with separate connectors, in which case, the stud cover 107 is removed, preferably without the need for tools, and discarded. Then connections are made to the distal stud 108 and the proximal stud 106 using commonly available snap fittings or grabber fittings, which are generally used on ECG cables.

Various modifications can be made to the instant invention by persons of ordinary skill in the art that would not depart from the spirit of the invention or the scope of the appended claims. For  
5 example, the distances between the studs, although currently proposed so as to be compatible with certain medical standards, could be varied. The shape and/or size of the studs, etc. can be different from those previously shown. The relative sizes of the  
10 studs can also be different. Other types of fittings could be substituted, and such fittings also would not depart from the spirit of the invention and the scope of the appended claims.